SOD1 gene

superoxide dismutase 1

Normal Function

The *SOD1* gene provides instructions for making an enzyme called superoxide dismutase, which is abundant in cells throughout the body. This enzyme attaches (binds) to molecules of copper and zinc to break down toxic, charged oxygen molecules called superoxide radicals. The molecules are byproducts of normal cell processes, and they must be broken down regularly to avoid damaging cells.

Health Conditions Related to Genetic Changes

amyotrophic lateral sclerosis

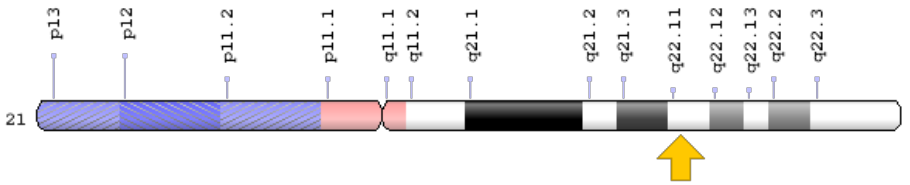
At least 200 mutations in the *SOD1* gene have been found to cause amyotrophic lateral sclerosis (ALS), a condition characterized by progressive muscle weakness, a loss of muscle mass, and an inability to control movement. Most of these mutations change one of the protein building blocks (amino acids) in the superoxide dismutase enzyme. About half of all Americans with ALS caused by *SOD1* gene mutations have a particular mutation that replaces the amino acid alanine with the amino acid valine at position 5 in the enzyme, written as Ala5Val or A5V. (Because of variations in the ways amino acids are counted in proteins, this mutation is sometimes called Ala4Val or A4V.) ALS caused by the A5V mutation is generally associated with a shorter life expectancy compared with ALS caused by other genetic mutations.

ALS is caused by the death of nerve cells that control muscle movement (motor neurons). It is unclear why these cells are particularly sensitive to *SOD1* gene mutations. Researchers have suggested several ways in which the altered enzyme may cause the death of motor neurons. These possibilities include an increase in harmful superoxide radicals, increased production of other types of toxic radicals, increased cell death, or accumulation of clumps (aggregates) of misfolded superoxide dismutase that may be toxic to cells.

Chromosomal Location

Cytogenetic Location: 21q22.11, which is the long (q) arm of chromosome 21 at position 22.11

Molecular Location: base pairs 31,659,622 to 31,668,931 on chromosome 21 (Homo sapiens Annotation Release 108, GRCh38.p7) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- ALS1
- Cu/Zn superoxide dismutase
- indophenoloxidase A
- IPOA
- SODC_HUMAN
- superoxide dismutase 1, soluble
- superoxide dismutase-1, soluble
- superoxide dismutase 1, soluble (amyotrophic lateral sclerosis 1 (adult))
- superoxide dismutase, cystolic

Additional Information & Resources

Educational Resources

- Biochemistry (fifth edition, 2002): Toxic Derivatives of Molecular Oxygen Such as Superoxide Radical are Scavenged by Protective Enzymes https://www.ncbi.nlm.nih.gov/books/NBK22505/#A2522
- Washington University, St. Louis Neuromuscular Disease Center http://neuromuscular.wustl.edu/synmot.html#so

GeneReviews

- Amyotrophic Lateral Sclerosis Overview
  https://www.ncbi.nlm.nih.gov/books/NBK1450

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28SOD1%5BTI%5D%29+OR+%28superoxide+dismutase+1%5BTI%5D%29%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+720+days%22%5Bdp%5D

OMIM

- SUPEROXIDE DISMUTASE 1
  http://omim.org/entry/147450

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/GC_SOD1.html
- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=SOD1%5Bgene%5D
- HGNC Gene Symbol Report
  http://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=11179
- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/6647
- UniProt
  http://www.uniprot.org/uniprot/P00441

Sources for This Summary

- Barber SC, Mead RJ, Shaw PJ. Oxidative stress in ALS: a mechanism of neurodegeneration and a therapeutic target. Biochim Biophys Acta. 2006 Nov-Dec;1762(11-12):1051-67. Epub 2006 Apr 4. Review.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16713195
- Bertolin C, D'Ascenzo C, Querin G, Gaiani A, Boaretto F, Salvoro C, Vazza G, Angelini C, Cagnin A, Pegoraro E, Sorarù G, Mostacciuolo ML. Improving the knowledge of amyotrophic lateral sclerosis genetics: novel SOD1 and FUS variants. Neurobiol Aging. 2014 May;35(5): 1212.e7-1212.e10. doi: 10.1016/j.neurobiolaging.2013.10.093. Epub 2013 Oct 29.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/24325798
- GeneReview: Amyotrophic Lateral Sclerosis Overview
  https://www.ncbi.nlm.nih.gov/books/NBK1450

- Rakhit R, Chakrabartty A. Structure, folding, and misfolding of Cu,Zn superoxide dismutase in amyotrophic lateral sclerosis. Biochim Biophys Acta. 2006 Nov-Dec;1762(11-12):1025-37. Epub 2006 May 22. Review.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16814528
- Shaw BF, Valentine JS. How do ALS-associated mutations in superoxide dismutase 1 promote aggregation of the protein? Trends Biochem Sci. 2007 Feb;32(2):78-85. Epub 2007 Jan 5. Review.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/17208444
- Tsang CK, Liu Y, Thomas J, Zhang Y, Zheng XF. Superoxide dismutase 1 acts as a nuclear transcription factor to regulate oxidative stress resistance. Nat Commun. 2014 Mar 19;5:3446. doi: 10.1038/ncomms4446.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/24647101
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4678626/
- Valentine JS, Doucette PA, Zittin Potter S. Copper-zinc superoxide dismutase and amyotrophic lateral sclerosis. Annu Rev Biochem. 2005;74:563-93. Review.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15952898

Reprinted from Genetics Home Reference:
https://ghr.nlm.nih.gov/gene/SOD1

Reviewed: March 2016
Published: March 21, 2017

Lister Hill National Center for Biomedical Communications
U.S. National Library of Medicine
National Institutes of Health
Department of Health & Human Services